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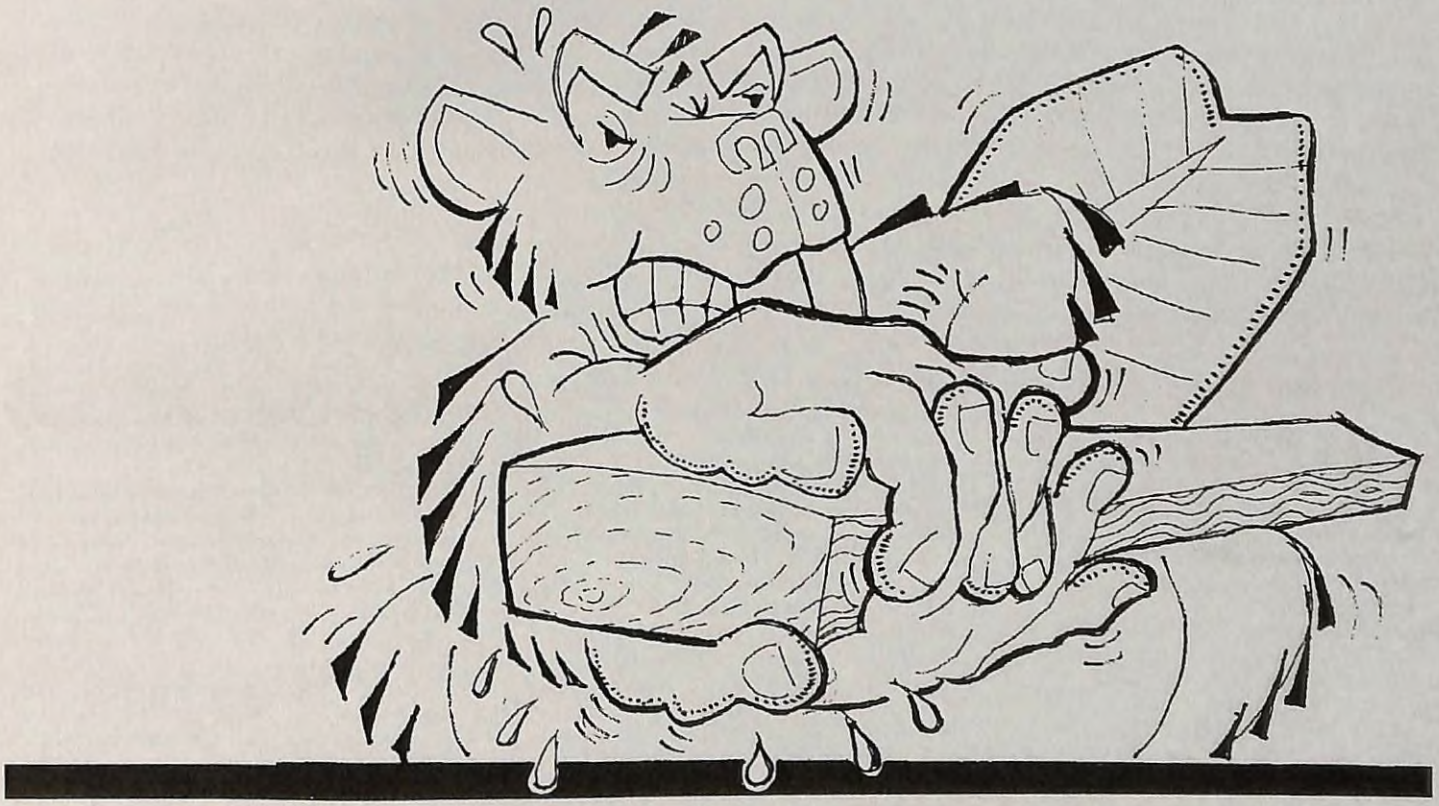
Contents . . .

Pressure Treated Wood 3
Guide to CSA 080 Standards by Product 4
Working with CCA-Treated Wood 5
Borate as a Wood Preservative 6
Alternatives to Pressure-Treated Wood 7
Wall Drying: Putting Theoretical Knowledge Into Practice 8
Wood Durability Information 8
Airtight Construction is Fire Resistant 9
Procurement List for the R-2000 Standard 10
Carbon Monoxide Safety Check 10
Myths about carbon monoxide 10
Letters to the Editor 11
Technical Research Committee News 13
Compatibility of Building Materials; CMHC Best Practice Guide for Engineered Wood Floor Joist Systems; Range Hood Fan Interconnect; Make-up Air Guidelines
All Weather Windows Drops Fibreglass Windows 14
Third Annual Edmonton Eco-Solar Home Tour 14
Mould: A Toxic Explosion? 15
Energy Answers 16
Moisture Management: Prediction of Response of Exterior Wall Elements to Climates 18

Pressure Treated Wood



From the Editor . . .

We live in an increasingly complex society. We need to set standards for our activities and to clearly define the limits for our actions since it is human nature to test boundaries of acceptable behaviour. That is why we develop all kinds of rules and regulations: from the laws that govern everyone, to the rules that govern the activities of voluntary organizations to which we belong, and to the standards that apply to specific products.

Many get angry at the mere mention of regulations. However, we need to remember that the intent behind most regulations is honourable, i.e. to set minimum standards and provide guideposts for the limits on activities – and to curb excesses. Although few would argue about the intent of most standards, at one time or another we all get hot under the collar when we are not happy with specific interpretations or applications of them. Yet we need some form of oversight, as mistakes happen and occasionally corners are intentionally cut to save a bit of time or money to the detriment of our customers or society. No one would admit it, but we've all probably been caught at one time or another.

Those who draft regulations would like to believe they are all straightforward and simple to follow, but that is not always the case. Existing building codes have evolved into complex and confusing documents. Part 9 of the National Building Code, the current regulations that apply to single family dwellings, include mostly prescriptive requirements that minimize the need for professional design. Prescriptive requirements are intended to be easy to follow, but they do limit the use of alternatives and may not always keep up to date with new technologies. Unfortunately, over time, the code has become more complex in its interpretation.

Coming changes in the format of the codes will have a big impact on construction because the new version will be an objective-based code. It is intended to clarify the objectives and intent behind code requirements in relation to code objectives. The new format will identify functional requirements that products, materials, procedures and systems must satisfy. In theory, this will facilitate innovation and should make it easier to comply without having to count nails.

Recently I've encountered several situations where even the existing provisions for dealing with equivalencies has become a challenge. When technically acceptable alternatives to prescriptive requirements were proposed, the building officials responsible had great difficulty accepting the details, even though there was a considerable amount of documentation and countless examples of its application in many jurisdictions.

I understand everyone has concerns about liability, and building officials probably see more than their share of idiotic details in the field. And increasingly all code interpretations are being done through a legal liability filter, with more emphasis on how to make a decision without taking any responsibility for it. But I also get concerned when the explanations questioning the alternatives or for not accepting them are also accompanied by a discussion that reveals a fundamental lack of understanding of basic building science principles.

We need to redouble our efforts to ensure that everyone in our industry has a good understanding of basic principles, and is able to evaluate new applications by considering first principles. It is equally important to know when one doesn't know enough about a subject, and to seek assistance at that point. Outright rejection of alternatives based simply on lack of knowledge is not good enough, yet that is what too often happens.

An objective-based code will require a higher degree of professionalism on everyone's part because the prescriptive crutch will no longer be there. It will require building officials, builders, and design professionals to have a solid understanding of building science principles, and an ability to fairly assess new technologies. And this is where I have concerns unless we start taking action now to ensure everyone in the industry is ready for the new, more demanding approach to dealing with and managing code use.

Richard Kadulski
Editor

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Pressure Treated Wood

As an organic material, wood is subject to organic decay. But used correctly, with proper moisture management, wood can be an extremely durable material.

Most of Canada has a continental climate with cold winters and warm summers. During the winter, decay organisms are dormant. In warm weather, decay organisms thrive when conditions are appropriate. In milder coastal regions, the warmer year-round temperatures and higher moisture levels make careful attention to construction details more important if we want structures to be durable.

Wood is used in many different applications, and we are using it increasingly where it should not be used – unless it is treated.

Changes in lifestyles and in designs have increased the number of applications for wood products. For example, today we build a range of garden structures. Until recently, naturally durable cedar and redwood were used for exterior applications. However, we are approaching the limits of available old growth cedar, so it is becoming more expensive and scarce. Other less durable species that can be treated are being used as an alternative.

Most pressure treated lumber goes into consumer rather than industrial applications. In Canada, about 13% of wood consumption is pressure treated. In the US, a higher portion of lumber is treated; in many regions, virtually all lumber sold for outdoor use is pressure treated. This may be explained in part by the milder climate and higher incidence of termites.

Wood deterioration problems are caused mainly by wood-rotting fungi, weathering, and insects. In most Canadian locations, insects are not a significant factor in wood deterioration. Most fungal species are active on wet wood. Only two species have the ability to move water from wet wood to relatively dry wood over inert surfaces. So controlling moisture will also control a major factor in wood deterioration. Wood scientists can readily predict the premature decay of inappropriately used wood products, but it may come as a surprise to wood users.

In the past, the shortage of naturally durable wood species in other parts of the world led to the increased use of wood that is less durable. Treating wood is not new. In the UK, oak was in short supply by the 18th century, leading to the development of wood treatments in the early 1800s.

In Australia and New Zealand, naturally durable wood species were logged out by the 1950s and the preservative treatment of plantation grown softwoods began – at a time when there was little concern about the use of chemicals.

Today there is a much greater awareness of the fragile state of the environment and the impact that human activity can have on it. There is a desire to avoid the use of pesticides where possible or, where unavoidable, to use the most benign pesticides in the smallest quantities necessary. On the other hand, there is a desire to make wood products last longer to offset their higher cost and ensure there is adequate time to grow the wood needed for eventual replacement.

In Canada, oil-borne preservatives were initially used to treat wood products that serviced the needs of railroads and utilities: mostly creosote railroad ties and utility poles. An increased demand for preservative treated lumber for consumer applications emerged only in the 1960s with lifestyle changes that meant more outdoor entertaining and activities at home. These uses rely on wood that has been treated with water-borne preservatives because the water-borne preservatives have a non-oily surface, making them acceptable for use in many residential applications. A perceived lack of maintenance was also a plus.

The main preservative used today is chromated copper arsenate (CCA). The copper provides a biocidal function, chromium is a fixative, and arsenic is a pesticide. Although the preservative does not prevent checking and splitting, it does reduce ultraviolet damage. CCA is used in a wide range of consumer applications (including decks and fences) and in some industrial uses.

Ammoniacal copper arsenate (ACA) and ammoniacal copper zinc arsenate (ACZA) have also been used, but in limited quantities and are being phased out.

Increasingly, borates are being used. Widely used in other countries, borates are water-soluble and can leach out if placed in locations subject to regular wetting. Borate treatment is also used for

insect control, especially in areas subject to termite infestations. Borates are used in pressure treated applications or as diffusion applications.

The National Building Code does not require the use of treated lumber except when it is in direct contact with the ground, or if framed into concrete below grade.

Wood preservation is covered by the CSA 080 series of standards, which are based on the American Wood Preservers' Association standards modified for Canadian conditions. The CSA 080 standard includes a number of standards based on applications. Recent changes include the removal of obsolete chemicals no longer used, and new treatment chemicals including borates. The revised CSA standard also requires testing of all

Guide to CSA 080 Standards by Product Application

The CSA 080 series of standards was originally based on the American Wood Preservers' Association standards, but has since deviated mostly because of the different regulatory climate and the generally lower biodeterioration hazard in Canada.

When the CSA 080 standards were originally developed, the residential treated wood market did not exist, so the existing standards are structured around a limited range of industrial commodities. New standards accommodate some residential applications, such as decking and shakes, but the CSA 080 series still needs updating. There has been little pressure for this work, since there is no requirement for residential treated wood to meet a standard other than permanent wood foundations and a few specific cases in the National Building Code.

Many wood products can end up being used in a variety of applications with different levels of risk. The major factor distinguishing these risks is the moisture content the wood will experience. Wood preservation standards in Australasia, Europe and the USA have been reorganized into systems based on location of use or risk hazard. Canadian standards are expected to follow suit.

Interior, dry

Applications inside buildings where the wood moisture content (MC) is normally below 20%, but may exceed this level for short periods.

Interior, damp

Applications inside buildings where there is a risk of wood MC between 20% and 30% for extended periods and/or exceeding this level for short periods.

Interior, with termites

Applications inside buildings located in regions where subterranean termites are known to be active, as these termites will introduce additional moisture.

Exterior, above ground (coated)

Applications where the wood is fully or partially exposed to rainfall, but has been coated with a factory-applied 3-coat paint finish to retard moisture uptake. In dry weather, the wood MC will vary from 10% to 18%. In wet weather, it may reach 80% or more, particularly where water is trapped in joints.

Exterior above ground (uncoated)

Applications where the wood is fully or partially exposed to rainfall, but not in direct contact with soil or moist concrete. In dry weather, the wood MC will vary from 10% to 18%. In wet weather, it may reach 50% or more, particularly where water is trapped in joints.

Exterior ground contact

Continuous contact with soil or with concrete within 150 mm of the soil. Wood moisture contents will normally be above 30%.

Fresh water

All or part of the wood is permanently immersed in fresh water. Wood moisture contents will vary from 50% in heartwood to 150% in sapwood.

Marine water

All or part of the wood is permanently immersed in seawater. Wood moisture contents will vary from 50% in heartwood to 150% in sapwood.

treated wood products to ensure fixation before they leave the treatment plant. All preservatives used must be registered by the Canadian Pest Management Regulatory Agency.

Concerns about preservatives

The use of preservatives always raises concerns, and has been under review for some time by Health Canada. In the US, the Environmental Protection Agency (EPA) is requiring a phase out of CCA-treated lumber because of its arsenic content.

Arsenic is poisonous in the short term and causes cancer in the long term, so it has come under increasing scientific scrutiny. It is the only known human carcinogen currently approved for use as a pesticide. Exposure to arsenic can cause lung, bladder, and skin cancer in humans, and is suspected as a cause of kidney, prostate, and nasal passage cancer. Arsenic-treated lumber is already strictly regulated in Japan, Germany, Australia and some other countries.

The primary concern about CCA-treated lumber is that arsenic could leach from newly treated wood. It is of special concern for applications where children are likely to come in contact with the treated wood. Arsenic can stick to children's hands when they play on treated wood, such as decks, stairs, or patio tables. It can then be absorbed through the children's skin or ingested when they put their hands in their mouths.

Currently available consumer information tends to ignore children, the most at-risk group. It tells contractors to wear face masks and gloves, but says nothing to families about playing or eating on arsenic-treated wood, what happens to the wood when it gets wet, avoiding cross-contamination with toys, the effect on pets, and other household hazards.

the Environmental Protection Agency (EPA) is requiring a phase out of CCA-treated lumber because of its arsenic content.

A US study looked at treated lumber purchased from retail building material outlets in various parts of the country. Based on the average arsenic levels detected, the study estimated that one of every 500 children who regularly play on playground equipment or decks made from pressure-treated wood can be expected to develop cancer later in life as a result of this exposure.

Arsenic levels drop significantly as the wood ages, so there is no need for homeowners to remove existing decks and other structures made with treated wood. Painting the lumber or coating it regularly with a sealant is suggested as one way to reduce arsenic risks.

Arsenic is classified as a "known human carcinogen" by the U.S. EPA and the World Health Organization. Children are at greater risk from arsenic than adults because they are less able to metabolize the metal. An average five-year-old, playing less than two weeks on a CCA-treated play set would exceed the lifetime cancer risk considered acceptable under US pesticide laws. A recent study by the University of Florida found that the lifetime increased risk of cancer for children regularly touching pressure-treated wood was as high as 1 in 1,000, a thousand times the risk deemed acceptable for pesticides under US federal law.

Those risks are significantly increased for children, whose growing bodies are more susceptible to the harmful effects of arsenic.

Working with CCA-Treated Wood

Treated wood is not a substitute for good building design. CCA-treated wood should be used only when such protection is important, where the wood is subject to decay or insect attack or is in contact with damp soil or water. CCA-treated wood should be used in the interior only when there is a risk of accidental wetting and replacement is difficult (for example, in foundations, basements, ground-floor joists and sub-floors).

Wear gloves, a dust mask, goggles, and long sleeves when working with treated wood to avoid skin contact with or inhalation of sawdust. Where possible, cut or otherwise work with treated wood out-of-doors. Wash hands after working with the wood, and before eating, drinking, or smoking. Launder clothing before reuse and separately from other clothing items.

Treated wood is not a substitute for good building design

Use corrosion-resistant fasteners to minimize damage and discolouration caused by moisture.

If the wood is cut during construction, apply an appropriate "end-cut" preservative (e.g., copper

naphthenate for above or below ground or zinc naphthenate for above ground only) to protect exposed, untreated wood. Use these products according to the manufacturers' instructions.

All cut ends, sawdust and construction debris should be cleaned up and disposed of in accordance with local regulations. Do not dispose of CCA-treated wood or sawdust in compost heaps, wood chips, or mulch as chemicals from the preservative may enter the food chain. Never burn treated wood as arsenic and chromium may be released into the environment as part of the smoke or remain in the ashes.

Dispose of construction wastes or material removed from service in accordance with local regulations. Contact your municipality or provincial government to find out how to dispose of CCA-treated wood in your area. (Most areas use ordinary trash collection or burial.)

The service life of CCA-treated wood may be extended by regular application of coatings or sealers, which can protect the wood from weathering effects. Such maintenance may also reduce the potential release of toxic chemicals from the wood.

Do not use bleaches, deck cleaners or brighteners that contain sodium hypochlorite, sodium hydroxide, sodium percarbonate, oxalic acid, or citric acid as they may release toxic chemicals from CCA-treated wood.

Do not use CCA-treated wood where:

- direct contact with food is possible (e.g., cutting boards, counter tops, patio tables, beehives);
- the chemicals in the preservative may enter the food chain (e.g., animal feed storage, silos, water troughs, compost bins, mulch); or
- the chemicals in the preservative may come into contact with public drinking water (e.g., well or reservoir covers), except for uses involving incidental contact such as docks and bridges.

Reuse treated wood wherever possible.

Alternatives to Pressure-Treated Wood

A number of manufacturers are now making products that are equivalent to preservative-treated lumber when subjected to insect and fungi attack, and can be used as an alternative to preservative-treated or naturally durable lumber.

These products can be worked just like wood, and any standard method of deck fastening can be used - screws, nails or clips. Most are designed for use as flooring for exterior balconies, porches, deck surfaces, walkways, boat docks and non-structural trim and guard-rail components. They are not for use in structural framing applications.

ChoiceDeck®

Weyerhaeuser manufactures a composite wood fibre and recycled polyethylene product, **ChoiceDeck®**, that has a natural redwood tone when manufactured but ages to a silver-grey colour after exposure to the sun, much like cedar siding. ChoiceDeck's finished profile has a texture similar to a resawn plank. It comes with a 20-year warranty against rot or fungal decay or termite or insect damage.

Information: Weyerhaeuser Corporation
www.choicedeck.com

Weatherbest™ Composite Decking and Railing

Louisiana Pacific Corporation makes a composite material marketed under the **WeatherBest™** name. This is a composite material that contains more than 50 percent wood fibre by weight with the remainder of the materials predominantly thermoplastic polymers. WeatherBest is made by an extrusion process to produce lumber-sized members up to 2 inches thick and 6 inches wide (these are nominal dimensions).

The 2 x 6 inch nominal composite hollow planks for deck surfaces can be used over wood or other structural members spaced up to 24 inches on centre. A trim piece is available to conceal the hollow ends of the planks. WeatherBest can carry a uniform load of 100 psf when applied over appropriately sized joists at 16 or 24 inches on centre.

Information: Louisiana Pacific Corporation
www.weatherbest.lpcorp.com

Borate as a Wood Preservative

Borates have been used as a wood preservative for more than 50 years. Until recently they have not been widely used in North America because CCA, which is better suited for use in a larger range of applications, has been the preferred preservative treatment.

Most construction lumber in New Zealand has been borate-treated for more than 40 years. In Hawaii, which now requires all framing lumber to be preservative-treated, borates have been the dominant choice since 1994.

Borate preservatives are virtually non-toxic to mammals and are environmentally benign. They are safe around people, and emit no vapours or effluents. Borates are inorganic salts that are odourless, colourless and non-corrosive. They do not degrade fasteners, caulking, plastics, rubber or other building materials, and are found in household cleaning products such as soap powder. Borate-treated wood is not considered a hazardous waste.

Borates are effective in stopping most of the pests that eat wood, including wood-destroying fungi, termites, carpenter ants and wood-boring beetles, and are considered to be a healthier and more environmentally-sound wood treatment approach. A small amount of borate in the wood, about 0.2% by weight, stops wood-boring beetles and most fungi. About 0.3% stops most termites, but 0.8% is needed to stop Formosan subterranean termites.

A big difference between borates and other preservatives is that borates spread through the wood naturally by diffusion. This is because they are water-soluble and can use the available moisture in unseasoned (green) wood to help diffuse completely throughout the wood. Borates can also penetrate difficult-to-treat Canadian species.

An advantage of total diffusion, compared with the surface treatment of other preservatives, is that a borate-treated piece of wood can be cut without concern for treating the cut. CCA treated wood, on the other hand, needs to be brushed with preservative in the field when the wood is cut.

The limitations of Borate-treated wood

Borates are water-soluble, which helps when treating the wood, but limits the applications where the wood can be used. Borate-treated wood must not be used where it will be in prolonged contact with soil or water, due to the risk that the preservative will wash out of the wood. However, borates will not leach out in the presence of humid air or small amounts of moisture. Temporary exposure to modest wetting during construction, for example, has not been found to significantly reduce the boron level.

Borate-treated wood is best used in weather-protected circumstances, away from ground contact. Its primary use is inside the moisture barrier, in-board of the sheathing paper. It is ideal for framing lumber in new buildings located where there is a risk of termites. Another good application is for parts of buildings that are difficult to keep dry, such as sill plates. But borate-treated sill plates still must be separated from concrete by a closed-cell foam gasket. Borate-treated wood can be stained or painted, so long as the wood is dry at the time. No special fasteners are required with borate-treated wood.

Methods of borate treatment

Commercial treatment is typically a combination of pressure treatment and a period of diffusion to disperse the preservative naturally. Pressure treatment with borates is covered by CSA 080.34-97. Unlike most other preservatives, borates work in green lumber – in fact, they require moisture in the wood to diffuse properly. For most wood species, borate treatment does not require incising of the lumber.

Because borates are colourless, typically a dye is added to the treating solution so that treated can be distinguished from untreated wood.

Wall Drying: Putting Theoretical Knowledge Into Practice

Last issue we presented the results of several laboratory studies that measured the rate of drying of various construction assemblies. The studies were designed to fill some very fundamental knowledge gaps about the performance of wall systems and their ability to dry when wet. These were scientific tests that, by design, did not completely deal with "real world" conditions. Our challenge is how best to apply the theoretical scientific information now available to conditions found in the field.

Moisture accumulates in the building envelope when more moisture enters the assembly than is removed – that is why there is so much interest in systems' drying ability.

Most design and analysis work is done for "design -day" conditions, which are the most extreme conditions likely to be encountered. These conditions could be considered as bookends. Most of the time, the conditions are somewhere between the summer and winter extremes. This means that moisture flows could go both ways, from inside to outside and outside to inside – usually from warm to cold, and from an area of more to one of less moisture. This also means that drying could take place both ways.

What must be remembered is that conditions that create the driving forces for moisture and vapour drive vary with the time of year, time of day, and even with orientation. For example, if the direction of prevailing storms is from the southeast, the southeast wall may be wet during a storm. As soon as the rain stops and the sun comes out, it warms the wall surface. Depending on the time of year and time of day, the wall temperature could become very hot – much warmer than the interior surface temperature. That would lead to a vapour drive toward the interior (also known as reverse vapour flow), especially if the material is able to absorb moisture, but this could be only on one orientation. When the sun sets, and the temperature cools down at night, the vapour drive reverses, and the moisture drive returns to outward.

Whether or not a problem arises in such a wall would depend on the amount of wetting, the ability of the construction materials to store moisture, and the ability of the assembly to dry out. The concern for building durability is if moisture accumulation exceeds the materials' ability to store the moisture or to shed the water.

Such dynamic conditions may seem confusing. At first glance it may seem that all we have been promoting in recent years should be ignored. However, that is not the case at all. Moisture must be controlled by controlling moisture entry and accumulation, and by moisture removal. Buildings still need to be airtight, because air movement through the envelope is a major source of moisture movement. There still needs to be a vapour retarder, but this becomes an issue of the properties of the vapour retarder and the nature of the construction assembly.

Strategies to keep water out may not be effective if the construction assembly starts out being wet. What is effective at keeping water out may also prevent water inside the assembly from drying up.

Most construction materials are able to store some moisture. Joe Lstiburek has estimated that a typical 2,000 sq. ft. house with masonry exterior walls and brick veneer can safely absorb up to 500 gallons of moisture without deterioration. Wood siding and structural lumber has the ability to safely hold about 50 gallons of moisture (assuming it is evenly distributed) before it reaches critical conditions. On the other hand, gypsum and steel studs have virtually no moisture storage capacity - able to absorb only about 1 gallon.

We understand the importance of detailing construction assemblies to keep the water out. Even though occasional problems will arise, we know what is needed to keep the rain out of the envelope. In all cases we need to build exterior assemblies that are vapour and air tight. What becomes more of a challenge is understanding the relative significance of air and vapour drives. Although in most circumstances water vapour is less important quantitatively, it can contribute to moisture loading into a building assembly, depending on the building's location and the environmental conditions.

In very cold climates, the conditions are sufficiently uniform most of the time. A good interior vapour barrier and an interior air barrier are the appropriate details to use. This allows drying of the construction assembly to go to the exterior.

In milder mixed climates, such as those in coastal areas of BC, the situation is more complex. Moisture flow could be from inside or outside. The assembly must be airtight, and interior humidity levels need to be controlled. The construction must be somewhat permeable so that vapour diffusion can move through without accumulating. Vapour-driven moisture flow will tend to be from the interior to exterior during the heating periods, and from the exterior to interior during cooling periods. An example of a semi-permeable vapour diffusion retarder is a three coat latex paint on gypsum board.

Another alternative is to place the vapour barrier in the middle of the wall. This could be impermeable insulation sheathing, such as extruded polystyrene, or foil faced isocyanate insulation.

A more detailed discussion on this issue is presented by Joe Lstiburek in the ASHRAE Journal, and available for viewing on the Building Science Corporation web site: www.buildingscience.com

Wood Durability Information

The Canadian Wood Council and Forintek Canada Corp. have a joint Web site dedicated to wood durability issues. The site is designed to offer a one-stop shop for information on wood design and wood science to ensure the long-lasting service of wood in construction. It provides useful information to designers, builders, and the general public.

Content includes tips for practitioners, the latest news on treated wood, extensive frequently asked questions, and links to other wood related sites.

www.durable-wood.com

Also, check the Canadian Wood Council's Web site: *www.cwc.ca*

Airtight Construction is Fire Resistant

A fire is always a tragic event. However, the investigation that follows offers an opportunity to learn how the building behaved in a fire, and if there are lessons to be learned for the future.

In early September, a fire broke out in the building housing the offices and library of CHBA-BC, located on the campus of the BC Institute of Technology. The fire started on the exterior of the building adjacent to an exterior staircase, went up the wall into the vaulted roof assembly which was vented - likely through soffit venting - and out the upper vent. However, a ridge beam to the underside of the roof deck separated the vent space, and so stopped the flames from spreading to the other side of the roof. There was damage to the roof and considerable smoke and water damage in the building, the result of the firefighting efforts, but the structure was not destroyed.

The fourteen-year old building was built as a showcase of R-2000 construction principles. The exterior walls were fully insulated and sheathed with rigid insulation. The entire structure was built airtight. It has been speculated that this construction approach may have played a role in limiting the damage. Typically, a fire on the exterior will enter the interior through places of air leakage, such as around window and door frames which usually are not sealed airtight. In this case, because of the airtight envelope construction, the fire was not able to breach the exterior envelope. The tightly built and fully insulated cavities meant there were few air gaps for oxygen to feed a fire in the structure itself, and thus limited damage to the exterior skin.

Investigators are still studying the cause of the fire.

*The Envelope Drying Rates Analysis (EDRA) Study (**Do Walls Dry Once They Get Wet**, which was described in Solplan Review No. 105 - July 2002) was conducted as part of the program of the Building Envelope Research Consortium (BERC), an industry/government consortium led by Canada Mortgage and Housing Corporation (CMHC), British Columbia Housing Management Commission (BCHMC) and the Homeowner Protection Office (HPO) of British Columbia. In the final editing, the note giving credit to the financial supporters was dropped, so we are including it here.*

This research was undertaken by Forintek Canada Corp at their western laboratory in Vancouver, B.C. The project was financially supported by a consortium including: Canada Mortgage and Housing Corporation, Forintek Canada Corp, the BC Homeowner Protection Office, BC Housing, du Pont, HAL Industries, Canadian Wood Council and Polygon Homes Ltd. Material donations to the project were provided by B.C. Wall & Ceiling Association, the Structural Board Association, CanPly and Richmond Plywood Corporation.

Procurement List for the R-2000 Standard

The R-2000 Standard requires home builders to incorporate building materials that are selected to improve the indoor air quality and to use environmentally appropriate materials with recycled content. Indoor air quality can be improved by the use of interior finishing materials that have lower initial emissions. Materials manufactured from recycled raw materials have a lower embodied energy content and a lower impact on the environment.

The appropriate criteria are outlined in lists, which are appended to the R-2000 Standard. The challenge for some is to locate and acquire suitable building materials. CMHC's Building Materials for the Environmentally Hypersensitive, although it may be somewhat out of date, is still a valuable resource for evaluating materials meeting indoor air quality requirements. Environment Canada's Environmental Choice program is a good resource for environmentally acceptable building materials.

However, neither of these two provides all the answers. Unfortunately, nor do suppliers, who often lack adequate knowledge of the products they represent. CHBA is working on a product procurement list database to help builders work with the R-2000 Standard.

In the next issue of Solplan Review, we will provide preliminary findings. In the meantime, if any readers have products or sources for materials that would meet the requirements of the R-2000 Standard Pick list, please let us know. Often these products are made available by smaller regionally based manufacturers or suppliers who have limited resources to do national marketing.

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000 www.R-2000.ca

Carbon Monoxide Safety Check

There are many potential sources of carbon monoxide (CO) in a home. These include unvented cooking appliances, as well as vented appliances such as wood burning stoves or fireplaces, gas, oil or wood furnaces and water heaters, gas appliances, attached garages, tobacco smoke, and blocked chimneys.

Even airtight, sealed-combustion, fuel-burning appliances are subject to spillage of combustion flue gasses. At the moment, they are not tested for spillage resistance. *That is why CO detectors are now required in all R-2000 homes with any combustion appliance or attached garage.*

CO is of concern because it is a deadly gas, whose effects on health are related to its level of concentration and the length of exposure to it. As we gear up for the winter, a time when homes get closed up, it may be appropriate to do a preventive maintenance check. Renovators and mechanical contractors should always put CO on their list of things to check for. If there is a CO detector in the house that has been there more than about four years, it should be replaced because its sensors have a limited life span.

Since CO is a colourless and odourless gas, only proper testing equipment can verify its presence. However, there are some visual clues that may indicate the presence of CO. These include:

- Rust, scale soot or any other deposits on burners, in the heat exchanger, in the vent and in any appliance clean out.
- Loose or disconnected vent/chimney connections
- Debris or soot falling from chimney connections
- Moisture on the inside of windows

Myths about carbon monoxide

Source: Bacharach Inc. a manufacturer and supplier of scientific equipment. www.bacharach-inc.com

Myth: Cracks in a heat exchanger can produce CO
Fact: Heat exchanger cracks alone do not produce CO. If a crack exists, and CO is being produced in the combustion process (because there is too much fuel or not enough air), then there is a probability that CO can escape through the crack and into the distribution air.

Myth: There is always CO in the flue gasses.
Fact: CO is produced when not enough air is supplied to a combustion appliance for the combustion process. The fuel and air balance can change in a matter of minutes, leading to CO production.
Fact: CO can be diluted by other gasses, producing lower readings when sampling in some locations. The sampling location must be close to the combustion and upstream from any draft diverters.
Myth: Heating equipment produces standard levels of CO.
Fact: Properly adjusted equipment will produce none or very small amounts of CO. Regardless of the amount of CO produced, it is important to have the flue gasses properly vented to the outside of the building.

Myth: General-purpose leak detectors measure CO.
Fact: General-purpose leak detectors do detect CO, but it is not recommended that they be used for problem analysis because their sensor is not CO-specific.
Myth: Instruments do not need to be calibrated regularly.
Fact: All electronic instruments using highly accurate gas-specific sensors must be calibrated on a known concentration of gas every six months, or more frequently if exposed to high levels of CO.

Letters to the Editor

Re: Rob Dumont's Energy Answers, Solplan Review No. 105, July 2002

I read, with much enthusiasm, Rob Dumont's Energy Answers column. I heartily agree with his directives for controlling loads before one thinks of mechanical solutions to overheating in the summer. However, I have the following observations and experiences to offer:

1. I frequently have to deal with consumers who call CMHC asking about air-conditioning sizing. Most enquiries concern existing houses. Obviously in such case, the ability to change solar exposures, plant trees, erect outdoor shades are limited - after all, we are talking about regular homeowners here. They want solutions and they generally want them now. The best I can advise in such cases is for consumers to invest in having a proper heat gain calculation done that takes into account the use of whatever types of shade they may have, reasonable expectations for interior temperatures, and the actual building envelope dimensions and R values. Next is the selection of an air conditioner that is one size smaller and as efficient and quiet as possible.

I admit that this gets nowhere near the ideals Rob is looking for, but for the consuming public it is likely the best we can hope for at this time. I noted with interest that the article by Mario Kani in the same issue of Solplan Review mentioned that some form of mechanical or other supplementary cooling over and above passive approaches was necessary in their designs despite best efforts to control loads.

2. There are many areas in Canada that experience hot humid summers. Montréal, Ottawa, and the entire "Golden Horseshoe" surrounding Greater Toronto are examples of areas with close to 1/2 the population of Canada that can experience extended periods of hot humid weather. Extremely hot weather was reported in Halifax this summer by a designer who tells me air conditioning is becoming increasingly popular in that area. In such climates, the ability of conventional buildings to shed or reject heat while recovering nighttime cooling is limited. While outdoor temperature may drop at night, relative humidities remain uncomfortably high and after three to four days of such weather, indoor conditions tend to get very uncomfortable.

3. I have seen three buildings constructed that have tried to make use of passive cooling approaches in hot humid climates of Montréal, Ottawa and Toronto. High R values, high thermal mass, low E windows, reduced infiltration, continuous supply and exhaust of air through heat recovery ventilators, and exhaustive shading techniques were employed. Unfortunately, after several days of hot, humid weather, the coolth of the buildings was exhausted and interior conditions quickly became unbearable. The buildings become heat traps that can't cool themselves off overnight. The buildings then tend to grow warts in the form of window air-conditioners quickly and hastily installed by unhappy occupants. It is questionable whether a building cooled by a number of window air-conditioners is more efficient than a well-engineered central cooling system.

I guess what I am getting at here is that one has to look very carefully at the climate of a location before passive cooling techniques can be recommended with any great confidence. If consumers are hell bent on having their indoor environment held at 22-24 °C and 30% - 50 % RH year round, I think this is a reality we have to deal with and come up with as many energy efficient, environmentally friendly options as possible.

I myself try to live by as many of Dumont's directives as possible. However, for the sake of domestic peace and harmony, I occasionally have to toggle the thermostat to "A/C", bite my lip and lower the temperature to marriage-saving levels.

Duncan Hill
Research Division CMHC
Ottawa, ON

Your comments underscore the increasing use of air conditioning. This points to one fact that we as a society are having a hard time acknowledging - that climate change seems to be upon us already, and will be for some time to come. We will have to reconcile ourselves to needing to work in an environment that is changing in ways we are not aware of. It means that the designs we build and details we use may have to change.

For the sake of future generations, let's hope we can quickly come to grips with the source of the climate change - our production of greenhouse gases, which are caused by our excessive use of energy in our vehicles and underinsulated buildings. Ed.

Re: It's Time to Sound the Alarm About High Capacity Exhaust Fans (July 2002, Solplan Review)

The article was a timely reminder about the problems that powerful exhaust devices can create in a house (i.e. combustion spillage/backdrafting, infiltration of soil gasses and the transfer of pollutants from attached garages). As the authors noted, the usual solution to these problems is to install a make-up air system that is interconnected to the offending exhaust devices.

While this is a workable solution, it does have serious limitations. First, the cost can be significant since a blower, controls, ducts, connections and possibly a pre-heater for the system may all be required. Collectively, these can cost in the order of $500 to $1500. Second, can we be sure the system will not be disconnected or otherwise defeated by the homeowners who may be concerned about wasting energy or the cold drafts or noise created by the system? Third, some make-up air systems can get complicated, which raises doubts about their long-term reliability (as a mechanical engineer, I have learned not to place unlimited faith in mechanical devices). Fourth, how do you interconnect a solid-fuel burning appliance to the make-up system to provide automatic control?

Why don't we, as an industry, simply move to eliminate the problem at its source? For example, we can continue to move away from spillage-susceptible appliances. The incremental cost of a direct vent natural gas furnace (compared to an induced draft unit) is now about $500 to $750, plus there is the added bonus of reduced heating costs.

A problem still exists if a natural gas water heater is used, although a better solution might be to use an electric tank with a greywater heat recovery system (which is now commercially available), or some other solution. Infiltration of soil gasses might still be a problem although the depressurization caused by most exhaust devices such as dryers is usually of short duration (an hour or two per day). Also, eliminating the standard B-vent could actually lower the average level of depressurization in the basement; if so, the net effect on soil gas migration would be to lessen the exposure. As for attached garages, the pressure differential that induces significant leakage is usually generated by wind action, so a make-up system would provide little benefit (although eliminating the B-vent will help). Overall, better airsealing at the garage/house junction is probably the best solution.

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Technical Research Committee News

Compatibility of Building Materials

All construction entails combining a number of materials in the finished building. For a long time we have known about product incompatibility, such as the galvanic corrosion that takes place when dissimilar metals are used together or in close proximity and where moisture can affect them. We are using many new formulations of materials today and entirely new materials that previously did not exist. Even seemingly similar materials designed for similar applications, such as roofing membranes and exterior caulking compounds, could be incompatible with each other.

Increasingly, builders are noting that material incompatibility can lead to serious problems. Unfortunately, there is no easy way to categorize and analyze all materials, and manufacturers do not always provide adequate information.

A CMHC funded project will be getting underway soon to create a template for a database that will contain information on known material compatibility issues. It is hoped that this will be a framework for adding information as it becomes available.

Canadian Home Builders' Association

CMHC Best Practice Guide for Engineered Wood Floor Joist Systems Moving Ahead

Engineered wood products are now widely used, but despite the best intentions of manufacturers, problems are still encountered in the field. Although engineered wood products have a profile similar to standard dimensional lumber, they do require special attention to handling and installation details. A new Best Practice Guide is going to be developed, which should provide a single succinct document that contains essential information for working with these products.

This will be a new addition to the growing file of Best Practice Guides that have been developed by CMHC. These include the Best Practice Guide: Brick Veneer Steel Stud; Best Practice Guide, Wood Frame Envelopes; Best Practice Guide, Flashings; and Wood Frame Envelopes in the Coastal Climate of British Columbia Best Practice Guide.

Range Hood Fan Interconnect

It seems that the media may indeed have the power to influence actions! For a long time the Canadian Codes Centre and CHBA, among others, have been expressing concerns about the need to be able to connect make-up air fans with large exhaust appliances, especially kitchen exhaust fans. This was also highlighted by John Haysom in Solplan Review (No. 105, July 2002).

Appliance manufacturers have maintained an ostrich-like stance, and have ignored all attempts to deal with the issue. This was in part because most manufacturers are based in the US where the construction tends to be much less airtight and the potential for dangerous combustion gas spillage is considered to be much less.

Jon Eakes, the host of a TV show on the Home & Garden channel, has decided to feature segments that deal with the issues homebuilders and homeowners should be concerned about if they are planning to install large capacity exhaust fans in a home. It seems that the manufacturers heard about this and may now be prepared to seriously respond to this problem.

Make-up Air Guidelines

All houses are subject to pressure imbalances. These are influenced by how airtight the house is, the exterior pressure differentials during windy weather, and the temperature difference driven by stack action in cold weather. In addition, a variety of appliances that exhaust air from the house may be installed, everything from bathroom and kitchen fans, dryers, fireplaces, wood stoves, furnaces and water heaters.

We know that the pressure imbalances must be kept to a minimum so residents' health and safety are not compromised. The building code has a requirement for maximum pressure imbalances, but this is seldom enforced. The CSA F-326 Residential Mechanical Ventilation Standard limits the allowable pressure difference to 5 Pascals if there are spillage-susceptible appliances in the house, and to 10 Pascals if there are none. The

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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challenge for builders is how to provide adequate make-up air if it is required.

Several years ago, CHBA published a document to help R-2000 builders that showed several ways to provide make-up air. A review of the Make-up Air Guidelines identified that the document needs to be updated. This has been put on the priority list, and it is hoped that a new updated document will be available soon.

If any reader has developed a make-up air strategy that is effective and easy to implement, please let us know or contact Jack Mantyla at CHBA directly.

All Weather Windows Drops Fibreglass Windows

All Weather Windows, based in Edmonton, has announced they are discontinuing production of fibreglass windows. Production resources will be shifted to wood metal clad windows and to increasing the capacity of their vinyl window lines. The decision reflects changes in consumer tastes that have increased the demand for wood windows. All Weather made the attempt to offer fibreglass windows as a mainstream product line, but sales volume did not materialize.

All Weather Windows has been a pioneer manufacturer of high performance windows, and was an early adopter of insulating spacers (using the SuperSpacer™ silicon spacers) in all their products.

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Arsenic-Based Pesticides – Harmful In Humans But OK In Trees?

Environmental concerns have meant that the use of arsenic-based compounds is declining. For example, CCA wood treatment is being phased out. However, spooked by a galloping pine beetle infestation in the central interior of BC, itself a direct result of climate change, the BC ministry of forests wants to inject trees in the Morice Forest District with more than 3,300 kilograms of an arsenic-based pesticide not legal for use in the United States since 1984.

Third Annual Edmonton Eco-Solar Home Tour

A dedicated group in Edmonton is organizing the third annual "Eco-Solar Home Tour" on October 19 as part of Edmonton's "Energy Awareness Week" (October 22-28.)

The Eco-Solar Home Tour is designed to show practical applications of energy efficiency and solar energy in the home, and how ordinary people are enjoying the benefits of less reliance on fossil fuels. It shows steps individuals can take to deal with global climate change issues. Previous tours have had more than 200 people participating.

Last year, the nine homes on the tour featured grid-connected solar PV, solar domestic water heating, solar pool heating, active and passive solar space heating, solar daylighting, water efficient appliances, electricity efficient appliances, R-2000 standards of energy efficiency, high quality indoor air, quietness and comfort levels.

This year's tour will expand to include sites with straw bale houses and wind power systems. The tour follows an open house format with a handout prepared for each house so that people can pick and choose which house(s) to tour. Sponsored by several Edmonton-area businesses and organizations that promote energy efficiency and solar products, the tour has a low budget, no entry fee, and is very easy to organize and promote. In turn, the public is eager to participate.

For information on how to organize an Eco-Home Solar Tour in your area, contact: Gordon Howell, (*ecosolar@compusmart.ab.ca*), or phone (780) 484-0476.

MOULD
A Toxic Explosion?

We are hearing a lot about mould today, so much that one would think there has been a mould explosion. The way the mainstream media has handled it, mould comes across as a plot from a B-grade science fiction movie come to life. Even a recent issue of Hazardous Materials Management, a pollution control industry trade magazine, had a cover headline in bright red letters screaming "Toxic Mould" over a photograph showing workers in space suits.

Is there really a mould explosion? Are we really seeing more mould, or is it simply that we are more sensitive to the issue? Is there cause for concern?

Much of the media attention has emerged from several high profile legal cases in the US. What has been lost in the coverage is that, although mould was present, there were other more significant factors implicated in each of the cases. It was not that mould alone was the problem, but rather that it was a highly visible symptom of other problems. Mould became the high profile target, while the real issues were serious moisture problems and how they were dealt with.

Mould is one of nature's essential creations that helps in the decomposition and recycling of organic material. Mould has always been part of the earth and is not something we will ever get away from. We need to be aware of and manage mould in our living and working environments.

When conditions are appropriate, most mould spores will germinate within 24 hours of wetting and will produce the next generation of spores within three to seven days. Once produced, the microscopic spores become airborne and can remain airborne and viable for a long time. There are thousands of varieties of moulds, each with its own requirements and properties. Some are good moulds, ones we rely on in our food and pharmaceutical industries.

A big challenge in dealing with moulds is that there is little direct clinical evidence to show the relationship between specific species of mould and human health, in part because the number of species is so large. However, we do know that there are human health impacts. Effects on health are varied, and can include allergic and toxic reactions. They are most pronounced for the very young, the elderly, and individuals with compromised immune systems. Symptoms can include allergic responses, headaches, eye, nose and throat irritation, nosebleeds, fatigue, coughs and suppression of immune functions.

In most situations, testing for moulds is simply not relevant. In fact, it is almost impossible because there are so many species, and each has its own optimum growing conditions. What is important is not to identify specific species, since that is something very difficult to do and in the end will not tell us about the source of the problem in our building environments. Rather, it is more important to recognize that moulds, especially in large concentrations, will impact health, and must be avoided.

The single factor that will affect mould growth is water. Moulds need moisture to grow. Controlling moisture sources will also control mould growth. If we are seeing more mould today, it is because there is more moisture in our buildings, and our buildings may be more sensitive to moisture. If construction assemblies are able to accumulate moisture quicker than it can dry out, they will be conducive to conditions where moulds may flourish. Even if a construction assembly will, on an annual basis, be able to dry out, there could be prolonged periods with high enough moisture content to permit mould growth.

Construction details must be climate sensitive. Some assemblies may be able to safely absorb quantities of moisture before critical moisture concentrations are reached. Providing they are able to dry out between wetting periods, the assemblies will perform safely. Perhaps we need to spend more time in allowing buildings to dry after wetting.

A number of excellent articles on mould can be found on the Building Science Corporation's web site: www.buildingscience.com

Energy Answers

Rob Dumont

Who makes the residential heat recovery ventilator (HRV - or air-to-air heat exchanger as it used to be called) with the lowest power consumption in North America?

To locate the most energy conserving HRVs produced in North America, I went to the Home Ventilating Institute (HVI) website (www.hvi.org). The site has a listing of performance characteristics of all the major residential HRVs. When selecting a heat exchanger, remember that the main criterion for selection is not necessarily low electrical energy use. Heat recovery effectiveness, quality, durability, availability of spare parts, ability to defrost in cold weather, experienced service people, core cross-leakage – all of these are important selection criteria in addition to electrical energy use.

I selected performance numbers for heat exchangers with measured HVI efficiency values at a flow rate of 30 litres/second (64 cubic feet per minute). This flow rate is lower than the installed capacity value of about 55 litres per second recommended for an average 3 bedroom house with a basement in the CSA F326 Residential Mechanical Ventilation Standard. However, Statistics Canada tells us that the average residence in Canada has about 2.5 occupants, and 30 litres/second of outside air for 2.5 occupants works out to 12 litres/second per occupant assuming that the house air is well mixed. Twelve litres/second (26 cfm) per occupant is lots of ventilation air provided that air pollutant sources are controlled.

A plot of the sensible recovery efficiency values for the air exchangers in the HVI database is shown in figure 1. The higher the sensible recovery efficiency, the warmer the air exiting the heat exchanger and entering the home will be. The efficiency and flow values are measured at an outside air temperature of 0°C (32°F). Note that the power consumption values range from a low of 49 watts (Nutech Lifebreath Model 155 Max) to a high of 134 watts (Nu-Aire Model NU-145V), and the sensible recovery efficiency values range from 61% to 81%. An ideal HRV would have zero power consumption, and a 100% sensible recovery efficiency. We are obviously not there yet. Apparently there is a German exchanger on the market in Europe that uses only 20 watts.

Ways that manufacturers can reduce power consumption include using more energy efficient motors (brushless DC motors seem to be the best), more efficient fans (backward curved airfoil fans are the best), low pressure drop heat exchanger cores (wide spacing of heat exchanger passages, turning vanes to redirect air flow inside the exchanger, low velocities), and low pressure drop filters. On the installation side, low pressure drop ductwork is important.

At an electricity price of 10 cents per kilowatt-hour, the annual electricity cost to run the highest power user (134 watts) 24 hours per day would be $117. In the high arctic, however, where diesel generated electricity at a cost of about 50 cents per kilowatt hour is commonly used, the annual running cost would be $587. A 20-watt heat exchanger would cost only $88 a year for electricity at 50 cents per kilowatt-hour.

The prime purpose of an HRV is to save energy. You can provide ventilation air to a house without an air exchanger (most houses in the world obviously do not have exchangers, but also do not have good air quality throughout the year).

One way to look at an HRV is to consider it as equivalent to a heat pump. You put electrical energy in and heat is recovered. Most heat pumps use a performance figure called a coefficient of performance. The coefficient of performance (COP) is equal to the useful heat output divided by the energy input. If the COP is 3, 1 kilowatt of electrical input will produce 3 kilowatts of heat output.

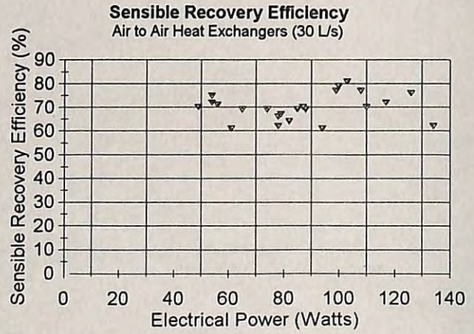

Figure 1. *Measured HVI Sensible Recovery Efficiency Values for HRVs (Performance Measured at an Outside Air Temperature of 0°C)*

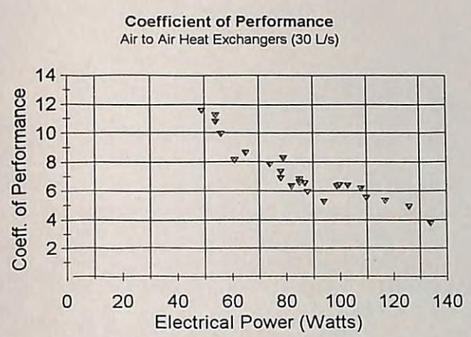

Figure 2. *Coefficient of Performance Values for HRVs (Performance Measured at an Outside Air Temperature of 0 °C)*

The COP of heat pumps is strongly dependent on the temperature difference over which the heat is being pumped. The colder the outside temperature for an air source heat pump, the lower the COP.

Air exchangers are similar to heat pumps in that a COP value can be assigned to them. One difference is that the COP of an air exchanger usually increases as the outdoor air temperature decreases (more heat is recovered as the outdoor air temperature drops).

In Figure 2 I have plotted the COP values for the air exchangers plotted in Figure 1. The COP values are for an outside temperature of 0oC (32oF). Note that the COP values are strongly dependent on the wattage of the heat exchanger. Thus the highest COP (11.6) is associated with the lowest consuming unit (49 watts), and the lowest COP (3.9) is associated with the highest consuming unit (134 watts). There is scatter in the data, but the general trend is a lower COP with higher wattage. The good news is that all of the units at this outside supply air temperature have a COP considerably greater than 1, i.e., the heat recovered is greater than the electrical energy input. The bad news is that in many parts of the country electrical energy is significantly more expensive than fossil fuel energy for heating. Thus, a high wattage heat exchanger will consume expensive electricity to conserve less expensive fossil fuel. Another discouraging conclusion is that most parts of the country have year round average outdoor temperatures that are considerably warmer than 0oC. For instance, even in chilly Saskatoon our average annual air temperature is +2oC. Thus the average COP of heat exchangers is lower than that shown in Figure 2 for most parts of the country.

It can be reasonably argued that a heat exchanger does more than just recover heat – the fans also distribute the supply and exhaust air throughout parts of the house. Thus the COP value is not a perfect measure of the total performance of the exchangers. COP is, however, a relatively good indicator of how efficiently the exchanger does its job.

Other things being equal, go for the low wattage exchangers.

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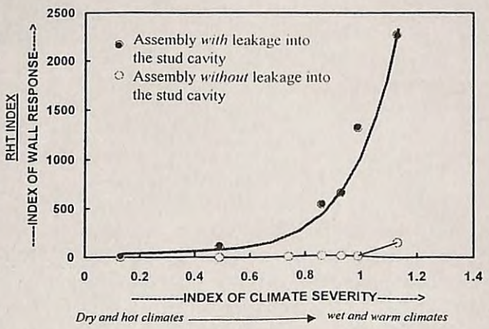
Moisture Management:
Prediction of Response of Exterior Wall Elements to Climates

Effective moisture control by the building envelope has a direct impact on its service life. It requires both minimizing the entry of moisture into the system and maximizing the exit of any moisture that manages to enter, so that no element stays too wet for too long. In 1998, the National Research Council's Institute for Research in Construction (IRC) initiated a comprehensive research project to develop a method that would help product manufacturers and building designers to evaluate the ability of building elements and assemblies to effectively manage external moisture in any geographic location in North America. The project – called MEWS (Moisture Management for Exterior Walls Systems) – focussed on low-rise wood-frame wall assemblies with the following four cladding systems: stucco, EIFS, masonry and siding (wood and vinyl).

The project included the following tasks:

- review of current construction practices; this was done to select wall materials, assemblies and common deficiencies for investigation in the project.
- laboratory measurements of hygrothermal properties of materials.[1] These were required to provide input for the mathematical modelling of wall assemblies. From these measurements, a database of hygrothermal properties for 40 common building materials has been produced.
- development of an index to rate the severity of any outdoor climate based on annual precipitation (wetting potential) and relative humidity (drying potential). For example, Phoenix has a much drier climate than Ottawa and it is unlikely that a given wall assembly will behave the same way in these two locations.
- laboratory investigation of water leakage into 17 large-scale wall specimens exposed to water spray simultaneously with air pressures, simulating wind-driven rain. This was done to gain insight on the role of deficiencies on water penetration into walls. It determined how much water gets into the stud cavity of wall specimens with and without "planted" deficiencies, under a variety of environmental loads. This information was used in the mathematical modelling.
- investigation of mathematical models to predict damage to wood-based materials. This requires an understanding of the precise environmental conditions that lead to rotting of wood materials. Moisture levels and temperature histories of materials are some of the major elements in this regard.
- development of a numerical indicator of the severity of the moisture and temperature conditions a wall material is exposed to. This indicator was called the "RHT" index, as in Relative Humidity (RH) and Temperature (T). The index provides an indication of the duration ("*how long*") and magnitude ("*how much*") of RH and T conditions above selected thresholds prevailing on a selected material within the wall assembly, once the wall is subjected to environmental loading (e.g., wind pressure, temperature and rain). The RH and T thresholds selected for the project were 95% RH and 5°C



Example of the predicted RHT response of a given wall assembly with and without leakage into the stud cavity (i.e. with and without deficiencies), as a function of the climate severity. The more severe the climate (the higher the value of the index on the X axis), the higher the "RHT" response (Y axis) for the wall with water leakage into the stud cavity.

[1] Related to heat flow and moisture transport, such as thermal conductivity and water vapour permeability.

- Computer simulations of over 400 wall assemblies with different material properties, subjected to actual climate loads recorded in seven North American locations, using IRC's advanced hygrothermal numerical model *hygIRC*. These simulations permitted the researchers to compare the RH and T conditions prevailing at a selected location in the wall assembly, using the RHT index. The simulations assisted the researchers in predicting whether a given change in the material properties or in the assembly of the wall made some change in the hygrothermal response of the wall exposed to some climatic exposures of a wide range of severity. The figure below illustrates how the results can be expressed graphically.

The MEWS project will be completed this year. Reports will be posted on the IRC website at http://*www.nrc.ca/irc/bes/mews/index.html* as they become available. Several Construction Technology Updates (see current series at http://*www.nrc.ca/irc/catalogue/ctu.html*) will be produced in 2003 and technical information derived from this project will also be disseminated at conferences and seminars.

Industry partners

The following industry groups participated in the project: Louisiana-Pacific Corporation, Marriott International Inc., Fortifiber Corporation, EIFS Industry Members Association, E.I. DuPont de Nemours & Company, Canadian Wood Council, Canadian Fibreboard Manufacturers Association, Canada Mortgage and Housing Corporation, Forintek Canada Corporation, Masonry Canada, Canadian Plastics Industry Association.

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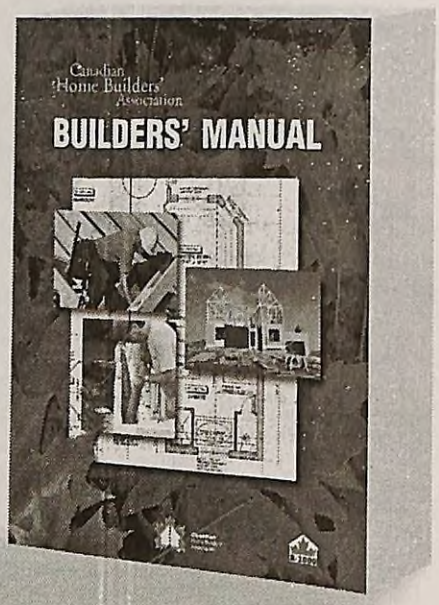

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